

Using any video-based computer system, the need soon arises to have a permanent record of the screen contents. It is sometimes also necessary to view more information than can be simultaneously displayed on a video screen. The recently introduced printer from Southwest Technical Products provides an economical means to fill the above needs. Costing only \$250 in kit form, the printer produces a surprisingly readable printout, and since the line length is identical with the Apple's (40 characters/line), the printed format is identical to the video format. Our experience using the printer as a peripheral to the Apple Computer has shown the printer to be a valuable tool in developing programs and a means to finally get a hard copy listing of that long BASIC program.

Interfacing the printer to the Apple Computer requires no additional parts other than a DPDT toggle switch! That's right, the printer can derive its data from the same source as the video terminal, with a slight modification to allow the video terminal to wait for the printer when it is printing a line. While this method of interfacing does not allow software control of the printer (you must switch the printer "on" to print, and can only print what is also outputted to the video display), it is extremely simple and inexpensive, and will fulfill the needs listed above without requiring special software. We feel it will meet the needs of many Apple Computer users.

### Theory of Operation

The Apple Computer uses a PIA (Peripheral Interface Adapter) to communicate with its on-board video terminal. The ASCII data is supplied by PIA lines PB0-PB6 (see schematic A). When the computer wishes to send a character to the display, it first samples PB7. If PB7 is a "zero", the display is "ready" for another character, if PB7 is a "one", the display is "not ready".

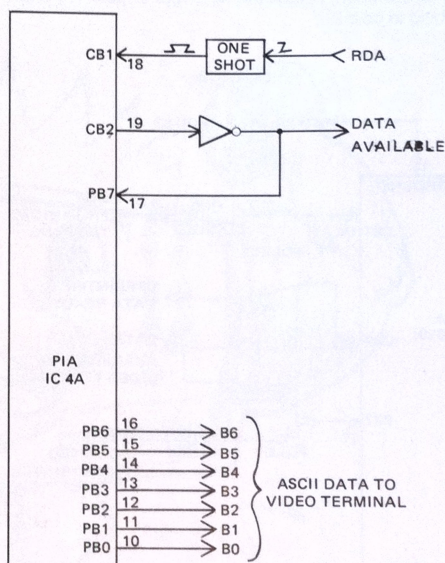
If the display is "ready" then the next character is transferred to the ASCII data lines (PB0-PB6) and DA (Data Available) is strobed "high". The Southwest Technical printer requires a UART style "data ready" strobe (negative strobe) which can be derived at pin 19 of the PIA (DA). This "data ready" strobe is routed through one pole of the toggle switch to let the user turn off the printer when it is not required.

The printer's DATA lines are wired to the same source as the video terminal DATA lines, PB0-PB6. The printer has its own internal 40 character buffer, and prints on only two conditions: 1) when the 40-character buffer is full, or 2) when it receives an ASCII carriage return. It can accept characters faster than the video display when it is not printing, however when it must print a line the video terminal must wait until the printing sequence has ended. This is done by switching the source of PB7 from its original source, DA (C15 pin 11) to the inverse of the "DATA ACCEPTED" signal generated by the printer. This will cause the character output subroutine (ECHO) in the Apple monitor firmware to wait until the printing cycle has ended (until PB7 goes "high") before outputting the next character. The "DATA ACCEPTED" signal from the printer is inverted using a spare NAND gate on the Apple board (C15 pins, 1, 2, 3). The source of the

# Interfacing the Apple Computer

by STEVEN JOBS

SCHEMATIC A



PIA CIRCUIT  
BEFORE PRINTER INTERFACE MODIFICATION

signal provided to PB7 is also selected through the same toggle switch, allowing the original signal from the video terminal to control PB7 when the printer is not being used.

### Installation

Ten wires between the Apple and the printer will carry all data and handshaking signals. You may wish to use a ribbon cable with a DIP connector and install a DIP socket in the Apple breadboard area to enable disconnecting the printer entirely. Refer to schematic B and wire the following:

NOTE: COLORS ARE USED FOR CLARITY ONLY

1) Connect the 7 printer DATA lines (ASCII bits 0-6) to the video terminal DATA lines at PIA pins 10-16



2) Connect the printer's "DATA ACCEPTED" output to IC 15, pins 1 and 2. IC 15 is a NAND gate which will invert this signal.

3) Connect printer GROUND to PIA pin 1 (Ground).

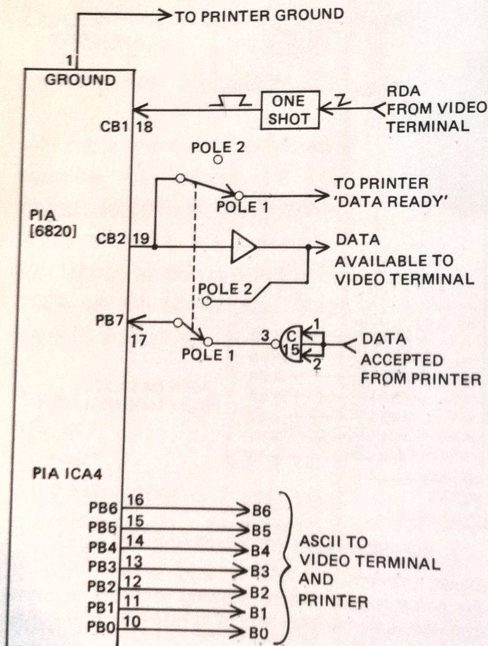
4) Connect a BROWN wire to IC 15, pin 3.

5) Connect a RED wire to PIA pin 19.

6) Do either: A) Cut the trace going to pin 17 of the PIA next to the pad of the PIA. Connect an ORANGE wire to the cut trace (follow the trace to a feedthrough, solder at feedthrough.) Connect a YELLOW wire to the pad of PIA pin 17. or, B) Lift the PIA from its socket and re-insert it with pin 17 hanging out. Connect an ORANGE wire to the pad of pin 17 and connect a YELLOW wire to the pulled pin.

7) Wire the DPDT toggle switch as follows: Side A—Attach the YELLOW wire to Common; Attach the ORANGE wire to pole 2; Attach the BROWN wire to pole 1. Side B—Attach the printer's "DATA READY" line to Common; Attach the RED wire to pole 1; Attach nothing to pole 2.

### SCHEMATIC B



PIA CIRCUIT  
AFTER PRINTER INTERFACE MODIFICATION

## Using the Printer

To use the printer, simply place the toggle switch in print position (pole 1 connected to common) before you wish to print. Whatever you or the computer output to the screen will also appear on the printer. Remember, the printer will only print after 40 characters have been

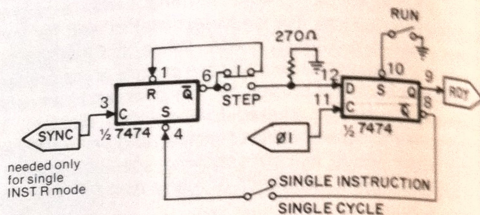
66 INTERFACE AGE

received or upon encountering a carriage return.  
the ASCII character set on the print.

To see the ASCII character codes, enter the following program in the Apple:  
0000: 8A E8 20 EF FF 10 F9 (CR)  
Then type 'R'.  
ATTENTION: Southwest Technical cautions that

**CAUTION:** Southwest Technical cautions that printing continuous lines without spacing between characters will overheat the solenoids on the printer and may decrease its operating life. Therefore do not run this sample program longer than 1 minute at a time. TO STOP THE PROGRAM hit "reset".

In conclusion, the SWTP printer has good printer quality for its class of printer, is easy to interface, and is affordable. It is a natural addition to the Apple Computer, and will increase the options and enjoyment of owning an Apple system.



(NOTE: Features not needed may be omitted)

### SINGLE STEP FOR 6502

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THIS IS FAIRLY GOOD, EH?  
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